PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference E-2490/04	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/EP2004/053134	International filing date *(day/month/year)* 26.11.2004	Priority date *(day/month/year)* 28.11.2003
International Patent Classification (IPC) or national classification and IPC B60B3/02, B60B3/06, B21D53/26, G01M1/34, G01M1/38		
Applicant IMT INTERMATO S.P.A. et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 9 sheets, as follows:
      ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
26.09.2005	27.02.2006
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Bolte, U Telephone No. +49 89 2399-7431

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2004/053134

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

4, 6-11	as originally filed
1-3, 5	received on 26.09.2005 with letter of 26.09.2005

Claims, Numbers

1-15	received on 26.09.2005 with letter of 26.09.2005

Drawings, Sheets

1/3-3/3	as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-15
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-15
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-15
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

State of the art:

Document (D1) EP 0 607 757 A cited in the search report and in the application forms the most relevant state of the art. It discloses a wheel balancing method and according to the preamble of claim 1.

Distinguishing features:

Claims 1 and 10 of the actual application are distinguished from the state of the art in that the balancing is effected by measuring inbalance and removing of material in two distinct planes lying separated from each other along the axle of the wheel.

Objective task:

Balancing of wheels was to be improved.

Grounds for the statement:

The subject-matter of the independent claim 1 is considered as new (Art. 33(2) PCT) (see above) and implies an inventive step (Art. 33(3) PCT), as none of the opposing documents gives a hint to accomplish the above task by performing balancing operations in two distinct planes. Claims 2 to 9 and 11 to 15 depending on claims 1 or 10 respectively refer to further embodiments of the invention. The system of claim 10 to perform the method of claim 1 is considered to be new and inventive accordingly.

The amended claims are based on the original claims and originally filed description page 9, line 18 - 26.

Industrial applicability:

The subject-matter of the present application is considered as industrially applicable (Art. 33(4) PCT) as it is used in the vehicles industry.

METHOD AND SYSTEM FOR PRODUCING ALLOY WHEELS FOR MOTOR VEHICLES

TECHNICAL FIELD

The present invention concerns a method for producing alloy wheels. Such a method according to the preamble of claim 1 is known from EP 607757.

BACKGROUND ART

Alloy wheels are being increasingly used in the automobile industry to equip both cars and small and medium-sized commercial vehicles and they are particularly appreciated because, besides giving the motor vehicle a particularly attractive appearance, they present mechanical characteristics, such as light weight and rigidity, that are decidedly better with respect to wheels made in the traditional way.

An alloy wheel presents an axle and comprises a hub, a rim, which are situated concentrically around the axle and an intermediate portion, which has the function of connecting the hub to the rim and is made in a very high number of models to give each wheel a distinctive character. Generally, the aforementioned models of the intermediate portion can be classified in a first family, according to which the hub and the rim are connected by a plurality of spokes, and in a second family, according to which the hub and the rim are connected by a perforated plate. Moreover, alloy wheels are made both in a single piece, that is the hub, the rim and the intermediate portion are formed of a single

piece obtained by casting or by forging, and in a number of pieces, generally two, that is the hub, a part of the rim and the intermediate portion are made in a first piece obtained by casting or forging, while a further part of the rim is made separately, also by casting or forging, in a second piece, which is later assembled with the first piece. The alloy wheel formed of several pieces is usually defined as being of compound type.

In both cases, the realisation of an alloy wheel contemplates a procedure of casting an alloy of aluminium or magnesium to make an untreated wheel or the pieces that make up the wheel, a heat treatment and a first and a second machining with a turning lathe. As an alternative to casting, the wheel is forged and, afterwards, subjected to heat treatment. The machining operations have the function of realising finished surfaces with high degrees of tolerance along the rim to guarantee a perfect coupling with the tyre and at the hub in the coupling area with the end part of an axle or of a semi-axle of a motor vehicle. The machining also has the function of eliminating burrs and of correcting any imprecisions derived from the previous operations. In other words, the untreated wheel presents eccentric masses which must be removed in such a way that the finished wheel, in use, is as balanced as possible in rotation around its own axis so as not to transmit vibrations to the motor vehicle.

Whereas said result was once accepted as satisfactory by the automobile industry, car manufacturers are now beginning to demand decidedly higher levels of balancing in alloy wheels since car manufacturers are, on the one hand, obliged to reduce the lead weights used for balancing wheels for environmental reasons and, on the other hand, to offer ever higher levels of comfort.

According to a method for producing alloy wheels for motor vehicles disclosed in patent application EP 607,757, the alloy wheels are realised and finished with a cutting machine tool. In particular, the above identified method comprises the steps of measuring the unbalance of said wheel, checking whether said unbalance is lower than an unbalance acceptability value by means of a control unit; calculating a mass to be removed and the respective phase with respect to a determined point on the wheel; said unbalance being identified by said mass and by said phase. The identified mass is removed by the cutting machine tool by offsetting the centre axis of the wheel.

Even though, the above method is a step forward in balancing the alloy wheel and allows reducing the lead applied to the outer side rim, it cannot solve completely the problem set forth above. In fact, EP 607,757 the dynamic unbalance is poorly compensate by machining the wheel by offsetting the axis of the wheel.

From DE 24,55,279 it is known a method for balancing the wheel with a mounted tyre by deforming the rim of the wheel. This technique is applicable solely to wheel made of malleable material such as deep drawn metal sheet.

DISCLOSURE OF INVENTION

The aim of the present invention is to provide a method for producing alloy wheels which is able to achieve balancing levels decidedly superior to those that can be obtained with the known methods without substantially increasing the production costs.

According to the present invention a method is supplied for producing alloy wheels according to claim 1.

The present invention concerns a system for producing alloy wheels for motor vehicles.

According to the present invention a system is realised for producing alloy wheels for motor vehicles according to claim 10.

indicates overall a substantially finished wheel, that is obtained by means of known processes of casting a metal alloy or of forging, subsequently subjected to heat treatment and machining. The wheel 1 comprises an axle 2 around which extend a hub 3 with a central hole 4, a rim 5 suited to house a tyre, not illustrated in the enclosed figures, and an intermediate portion 6 which in the illustrated example is defined by seven spokes 7, which are uniformly distributed around the axle 2 and connect the hub 3 to the rim 5. In the example illustrated in the enclosed figures reference is made to a wheel 1 made all in one piece with an intermediate portion 6 defined by seven spokes 7; of course the present invention extends to any type of wheel, in one piece or compound, and to any type of intermediate portion.

As better illustrated in figure 3, the rim 5 presents a substantially cylindrical wall 8 laterally delimited by two annular edges 9 and 10, which together with the wall 8 define a channel 11 suited to contain a tyre not illustrated in the enclosed figures. The wall 8 presents a face 12 facing towards the outside and along which will be performed the interventions for balancing the wheel 1. Moreover, (fig. 1 and 2) the wall 8 is crossed by a hole 13, which is suited to house the valve of the tyre, not illustrated in the enclosed figures.

C L A I M S

1. Method for producing alloy wheels for motor vehicles, each wheel (1) comprising a hub (3) and a rim (5); the method including realising a finishing operation with a cutting machine tool; the method comprising the steps of measuring the unbalance of said wheel (1), and checking whether said unbalance is lower than an unbalance acceptability value ($M1_{max}$; $M2_{max}$) by means of a control unit (35); calculating a mass (M1; M2) to be removed and the respective phase (F1; F2) with respect to a determined point on the wheel (1); said unbalance being identified by said mass (M1; M2) and by said phase (F1; F2); the method being characterised by calculating a first mass and a second mass (M1, M2) to be removed and the respective first and second phase (F1, F2), said first and second mass (M1; M2) being separated from each other along the axle (2) of the wheel (1).

2. Method according to claim 1, characterised by calculating a first and a second simulated mass (MS1, MS2) and the respective first and second simulated phase (FS1, FS2) in working conditions of the wheel (1), said first and second simulated mass (MS1; MS2) being separated from each other along the axle of the wheel; and by removing the first simulated mass (MS1) when the

first simulated mass (MS1) is not lower than a first unbalance acceptability value ($M1_{max}$) and by removing the second simulated mass (MS2) when the second simulated mass (MS2) is not lower than a second unbalance acceptability value ($M2_{max}$).

3. Method according to claim 2, characterised by removing the first and the second simulated mass (MS1; MS2) from the wheel (1) to compensate the unbalance when the unbalance is not acceptable.

4. Method according to claim 3, characterised in that the finishing machining process, the checking of unbalance and the possible removal of the first and second simulated mass (MS1; MS2) are carried out on a single cutting machine tool (24).

5. Method according to one of the claims from 2 to 4, characterised by calculating the first and second simulated mass (MS1; MS2) according to the first and second mass (M1; M2) and the first and second phase (F1; F2) and the mass of a valve (MV) and the phase of the valve (FV).

6. Method according to any one of the claims from 2 to 5, characterised by calculating a first and second geometry (G1; G2) of the respective first and second

simulated mass (MS1; MS2) according to the geometry (GR) of the wheel (1) and the specific weight (PR) of the wheel (1).

7. Method according to claim 6, characterised by calculating the first and second geometry (G1; G2) of said first and second simulated mass (MS1; MS2) according to the type of machining (LT) selected.

8. Method according to claim 7, characterised by determining the first and second coordinates (C1; C2) of said first and second geometry (G1; G2) with respect to a point of reference on the wheel (1).

9. Method according to claim 8, characterised by transferring the first and second coordinates (C1; C2) to a numerical control (38) of the cutting machine tool (24).

10. System for producing alloy wheels for motor vehicles, each wheel (1) comprising a hub (3) and a rim (5); the system comprising a cutting machine tool for carrying out finishing operation; the system comprising means for detecting (14; 40) the unbalance of said wheel (1) and means for checking (19; 46; 50; 51) whether said unbalance falls within an unbalance acceptability value ($M1_{max}$; $M2_{max}$); means for calculating a mass (M1; M2) to

be removed and the respective phase (F1; F2) with respect to a determined point on the wheel (1); said unbalance being identified by said mass (M1; M2) and by said phase (F1; F2); the system being characterised by comprising means for calculating a first mass and a second mass (M1, M2) to be removed and the respective first and second phase (F1, F2) with respect to a determined point of the wheel (1), said first and second mass (M1; M2) being separated from each other along the axle (2) of the wheel (1).

11. System according to claim 10, characterised by comprising means for calculating (17; 44) a first and second simulated mass (MS1; MS2) to be removed from the wheel (1) to correct the unbalance of the wheel (1) in working condition and the respective simulated phase (FS1; FS2).

12. System according to claim 11, characterised by comprising means for checking (19; 46; 50; 51) the first and second simulated mass (MS1; MS2) of the unbalance acceptability with respect to a first and second unbalance acceptability value ($M1_{max}$; $M2_{max}$).

13. System according to one of the claims from 15 to 19, characterised by comprising a cutting machine tool for removing said simulated mass (MS; MS1; MS2) from said

wheel (1) to compensate the unbalance, when at least one of the first and the second mass (MS1; MS2) is not lower than the respective first and second unbalance acceptability value ($M1_{max}$; $M2_{max}$).

14. System according to claim 13, characterised in that said cutting machine tool (24) comprises sensors (36, 37; 36, 37, 39) for detecting unbalance, a control unit (35) for calculating the first and second simulated mass (MS1; MS2) and the respective first and second phase (FS1; FS2) and the first and second coordinates (C1; C2) of said first and second simulated mass (MS1; MS2), and a numerical control (38) suited to acquire said coordinates; said cutting machine tool (24) being suited to carry out the machining finishing operation, to check the unbalance and eventually to remove the first and second simulated mass (MS1; MS2).

15. System according to claim 13, characterised in that said cutting machine tool (24) comprises a sensors for detecting the dynamic unbalance (36, 37; 36, 37, 39) and means for calculating the first and second mass in correspondence of a first and a second plane along the axis of said wheel.